between present species and those which lived in past ages. I may here, to give only one instance, refer to Huxley's important researches into the relations of the members of the family Equidæ, the Anchitherium, Hipparion, and Equus. At the same time the gulf between the different classes of vertebrates is being gradually bridged over by careful research. Thus Prof. O. C. Marsh has shown that the jurassic bird Archæopteryx from Solenhofen is closely connected with the Dinosaurs, generally considered to be most nearly allied to birds. Archæopteryx has besides true teeth in sockets, bi-concave vertebræ, the pelvic bones are separate, and the metatarsals either separate or at least imperfectly united. American fossil birds, such as Ichthyornis, have also bi concave vertebræ (like fishes and some Saurians), and teeth in sockets. The skull of *Otontopteryx toliapicus*, found in the Isle of Sheppey, in the London Clay, has also true teeth in sockets.

There is, however, in palæobotany still a great deal that is in many respects unsatisfactory and inconclusive. This is mainly owing to the fragmentary material at our command, consisting mostly of leaves, the determination of which in many instances may lead us to wrong inferences. To give only one instance, I wish to refer to O. Feistmantel's latest researches on the palæozoic and mesozoic flora of Australia, with which our own fossil flora is closely connected.

The eminent palæontologist of the Indian Geological Survey comes to the conclusion that Phyllotheca, in Europe and Siberia of jurassic age, is palæozoic in New South Wales, and upper mesozoic in Victoria; Glossopteris, palæozoic in Australia, is jurassic in India and Russia. Noeggerathiopsis, beginning to appear in palæozoic beds in Australia, is represented by the jurassic Rhiptozamites in Siberia.

It is unquestionable that such conclusions, before they can be adopted, have to be confirmed by evidence of a still more reliable character than the present material for comparison can have afforded.

Returning to the physical conditions under which the surface of our globe has been formed and is still forming, I may here point out that since evolution has been adopted by most scientific men as a beacon to guide them to truth, the greater portion of the so-called uniformitarian school of geologists, following in the footsteps of Lyell, has become somewhat modified in its views, and may now be called the evolutional school. But let me hasten to add that Lyell himself, with his great love for truth, may be claimed as one of its first disciples, he having reviewed his own writings by the light Darwin held up to us, which is sure to advance geology even more than we can at present realise.

There is one question of great importance, in the solving of which both the geologist and the palæontologist have to go hand in hand with the archæologist. There is no doubt that the human race existed already in pliocene times; and if we can trust the reports of discoveries in Portugal and other portions of Southern Europe, man may have lived as early as the miocene age.

However, we want further and clearer evidence before this latter view can be adopted. If we consider the enormous space of time that separates us from our first ancestors, the oldest historical facts preserved seem to us as of to-day; and taking into account the wonderful progress the human race has made from the condition of the cave-dwellers, with their rude stone implements, to our present state of civilisation, we ought to look proudly upon the position mankind has attained. And we can therefore scarcely conceive the high degree of perfection, both physically and mentally, the human race may reach in future.

Although, as far as our researches go, the autochthones of New Zealand cannot boast of great antiquity when compared with the inhabitants of the Northern Hemisphere or of the tropical regions, there is nevertheless strong reason to believe that this country has been inhabited for a much longer time than was formerly generally assumed.

It is, however, possible, that some of the traces we have hitherto found of the oldest occupancy of these islands may have been left behind by occasional visitors, adventurers in search of new countries, or by crews of wrecked ships coming from distant shores.

But we have only begun to examine these questions; and although, as is always the case, the wiseacres will first shake their heads, if our researches are only continued without fear and without preconceived conclusions, we may be certain that valuable results will be in store for us.

The existence of loess beds, often of considerable thickness, in numerous parts of New Zealand, of which many have begun to be deposited before the beginning of our great glacier period, will be of great use, and offer us an excellent field for research in this direction. These beds being of subaërial origin, not only the remains of land animals are preserved in them, but we shall find in them also the traces of man. I may here mention the strange fact that the true nature of these beds has for a long time been misunderstood and misinterpreted by most English geologists. Even in the last edition of Lyell's "Elements of Geology," the loess of the Rhine is described as fluviatile loam, whilst the author himself shows that only the remains of land shells and land vertebrates are embedded in it. It has always been inconceivable to me how such an error should have remained so long uncorrected; the more so as, as far back as 1847, Alex. Braun, in "Leonhard and Bronn's Neues Jahrbuch," has shown the true state of things, and German geologists have repeatedly furnished new facts in illustration and given analyses of loess and of recent and older fluviatile deposits of the Rhine for comparison.

But, as I have previously pointed out, the peculiar nature of the loess deposits—the minute vertical capillary structure caused by the empty spaces once filled by the rootlets of innumerable generations of grasses—is a sure guide even to a tyro in geology. This structure amongst these localities is well exhibited in the fresh cuttings near Lyttelton.

I fear that the time allotted to me will not allow me to enter more fully into a review of what has already been accomplished to make geology an inductive science, and what remains still to be done, but I may be permitted to allude to one of the principal causes that retarded geology from taking its present position. This was the fear of the student to enter into antagonism with the established religious cosmogony. It is unnecessary to allude to the middle ages, because the stake or disappearance in the dungeons of the holy inquisition were the rewards of fearless physical research, and men like Galileo and Descartes were obliged to use often evasive language, unworthy of such great thinkers, in order to preserve their lives or freedom, and therefore my remarks will only apply to our own times. In proof of this I wish only to quote one work, "Vestiges of the Natural History of Creation," of which the first edition appeared in 1844. If we read this book at the present time, we can scarcely understand how it could have created such intense indignation amongst a large portion of the community, or that so much could have been written against it. Lyell himself, when publishing his "Principles of Geology," a work of a true philosopher, was, judging from some letters in his biography, very careful not to hurt too much the prejudices of his time, not wishing to mar the usefulness of his work. Even at the present time are there not thousands and thousands of well-meaning but narrow-minded persons, at once entering into strenuous opposition when there is any reference made to scientific cosmogony differing from that they have been accustomed to from their youth, and that cannot stand before the light of modern research?

However, the great principle of liberty for the teacher, so well expressed by the German word "Lehrfreiheit," cherished by the whole Teutonic race, a principle even preserved in the German universities during the darkest days of absolutism, is a safeguard of inestimable value, possessed fortunately also by our New Zealand University, the *Alma Mater* for whose advancement to the highest attainable position and general utility we ought willingly to devote our whole strength and best energies.

DUST-FREE SPACES[1]

WITHIN the last few years a singular interest has arisen in the subject of dust, smoke, and fog, and several scientific researches into the nature and properties of these phenomena have been recently conducted. It so happened that at the time I received a request from the Secretary of this Society to lecture here this afternoon I was in the middle of a research connected with dust, which I had been carrying on for some months in conjunction with Mr. J. W. Clark, Demonstrator of Physics in University College, Liverpool, and which had led us to some interesting results. It struck me that possibly some sort of account of this investigation might not be unacceptable to a learned body such as this, and accordingly I telegraphed off to

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[1] Lecture to the Royal Dublin Society by Dr. Oliver J. Lodge, April 2.

Mr. Moss the title of this afternoon's lecture. But now that the time has come for me to approach the subject before you I find myself conscious of some misgivings, and the misgivings are founded upon this ground: that the subject is not one that lends itself easily to experimental demonstration before an audience. Many of the experiments can only be made on a small scale and require to be watched closely. However, by help of diagrams and by not confining myself too closely to our special investigation but dealing somewhat with the wider subject of dust in general, I may hope to render myself and my subject intelligible if not very entertaining.

First of all, I draw no distinction between "dust" and "smoke." It would be possible to draw such a distinction, but it would hardly be in accordance with usage. Dust might be defined as smoke which had settled, and the term smoke applied to solid particles still suspended in the air. But at present the term "smoke" is applied to solid particles produced by combustion only, and "dust" to particles owing their floating existence to some other cause. This is evidently an unessential distinction, and for the present I shall use either term without distinction, meaning, by dust or smoke, solid particles floating in the air. Then "fog": this differs from smoke only in the fact that the particles are liquid instead of solid. And the three terms, dust, smoke, and fog, come to much the same thing, only that the latter term is applied when the suspended particles are liquid. I do not think, however, that we usually apply the term "fog" when the liquid particles are pure water: we call it then mostly either mist or cloud. The name "fog," at any rate in towns, carries with it the idea of a hideous, greasy compound, consisting of smoke and mist and sulphur and filth, as unlike the mists on a Highland mountain as a country meadow is unlike a city slum. Nevertheless the finest cloud or mist that ever existed consists simply of little globules of water suspended in air, and thus for our present purpose differs in no important respect from fog, dust, and smoke. A cloud or mist is, in fact, fine water-dust. Rain is coarse water-dust formed by the aggregation of smaller globules, and varying in fineness from the Scotch mist to the tropical deluge. It has often been asked how it is that clouds and mists are able to float about when water is so much heavier (800 times heavier) than air. The answer to this is easy. It depends on the resistance or viscosity of fluids, and on the smallness of the particles concerned. Bodies falling far through fluids acquire a "terminal velocity," at which they are in stable equilibrium—their weight being exactly equal to the resistance—and this terminal velocity is greater for large particles than for small; consequently we have all sorts of rain velocity, depending on the size of the drops; and large particles of dust settle more quickly than small. Cloud-spherules are falling therefore, but falling very slowly.

To recognise the presence of dust in air there are two principal tests: the first is the obvious one of looking at it with plenty of light, the way one is accustomed to look for anything else; the other is a method of Mr. John Aitken's, viz. to observe the condensation of water vapour.

Take these in order. When a sunbeam enters a darkened room through a chink, it is commonly said to be rendered visible by the motes or dust particles dancing in it; but of course really it is not the motes which make the sunbeam visible, but the sunbeam the motes. A dust particle is illuminated like any other solid screen, and is able to send a sufficient fraction of light to our eyes to render itself visible. If there are no such particles in the beam—nothing but clear, invisible air—then of course nothing is seen, and the beam plunges on its way quite invisible to us unless we place our eyes in its course. In other words, to be visible, light must enter the eye. [A concentrated beam was passed through an empty tube, and then ordinary air let in.]

The other test, that of Mr. Aitken, depends on the condensation of steam. When a jet of steam finds itself in dusty air, it condenses round each dust particle as a nucleus, and forms the white visible cloud popularly called steam. In the absence of nuclei Mr. Aitken has shown that the steam cannot condense until it is highly supersaturated, and that when it does it condenses straight into rain—that is, into large drops which fall. The condensation of steam is a more delicate test for dust than is a beam of light. A curious illustration of the action of nuclei in condensing moisture has just occurred to me, in the experiment—well known to children—of writing on a reasonably clean window-pane, with, say, a blunt wooden point, and then breathing on the glass: the condensation of the breath renders the writing legible. No doubt the nuclei are partially wiped away by the writing, and the moisture will condense into larger drops with less light-scattering power along the written lines than over the general surface of the pane where the nuclei are plentiful and the drops therefore numerous and minute. Mr. Aitken points out that if the air were ever quite dustless, vapour could not condense, but the air would gradually get into a horribly super-saturated condition, soaking all our walls and clothes, dripping from every leaf, and penetrating everywhere, instead of falling in an honest shower, against which umbrellas and slate roofs are some protection. But let us understand what sort of dust it is which is necessary for this condensing process. It is not the dust and smoke of towns, it is not the dust of a country road; all such particles as these are gross and large compared with those which are able to act as condensers of moisture. The fine dust of Mr. Aitken exists everywhere, even in the upper regions of the atmosphere; many of its particles are of ultra-microscopic fineness; one of them must exist in every raindrop, nay, even in every spherule of a mist or cloud, but it is only occasionally that one can find them with the microscope. It is to such particles as these that we owe the blue of the sky, and yet they are sufficiently gross and tangible to be capable of being filtered out of the air by a packed mass of cotton-wool. Such dust as this, then, we need never be afraid of being without. Without it there could be no rain, and existence would be insupportable, perhaps impossible; but it is not manufactured in towns; the sea makes it; trees and wind make it; but the kind of dust made in towns rises only a few hundred yards or so into the atmosphere, floating as a canopy or pall over those unfortunate regions, and sinks and settles most of it as soon as the air is quiet, but scarcely any of it ever rises into the upper regions of the atmosphere at all.

Dust, then, being so universally prevalent, what do I mean by dust-free spaces? how are such things possible? and where are they to be found? In 1870 Dr. Tyndall was examining dusty air by means of a beam of light in which a spirit-lamp happened to be burning, when he noticed that from the flame there poured up torrents of apparently thick black smoke. He could not think the flame was really smoky, but to make sure he tried first a Bunsen gas-flame and then a hydrogen flame. They all showed the same effect, and smoke was out of the question. He then used a red-hot poker, a platinum wire ignited by an electric current, and ultimately a flask of hot water, and he found that from all warm bodies examined in dusty air by a beam of light the up-streaming convection-currents were dark. Now of course smoke would behave very differently. Dusty air itself is only a kind of smoke, and it looks bright, and the thicker the smoke the brighter it looks; the blackness is simply the utter absence of smoke; there is nothing at all for the light to illuminate, and accordingly we have the blankness of sheer invisibility. Here is a flame burning under the beam, and, to show what real smoke looks like, I will burn also this spirit-lamp filled with turpentine instead of alcohol. *Why* the convection-currents were free from dust was unknown: Tyndall thought the dust was burnt and consumed: Dr. Frankland thought it was simply evaporated.

In 1881 Lord Rayleigh took the matter up, not feeling satisfied with these explanations, and repeated the experiment very carefully. He noted several new points, and hit on the capital idea of seeing what a cold body did. From the cold body the descending current was just as dark and dust-free as from a warm body. Combustion and evaporation explanations suffered their death-blow. But he was unable to suggest any other explanation in their room, and so the phenomenon remained curious and unexplained.

In this state Mr. Clark and I took the matter up last summer, and critically examined all sorts of hypotheses that suggested themselves, Mr. Clark following up the phenomena experimentally with great ingenuity and perseverance. One hypothesis after another suggested itself, seemed hopeful for a time, but ultimately had to be discarded. Some died quickly, others lingered long. In the examination of one electrical hypothesis which suggested itself we came across various curious phenomena which we hope still to follow up.[1] It was some months before what we now believe to be the true explanation began to dawn upon us. Meanwhile we had acquired various new facts, and first and foremost we found that the dark plane rising from a warm body was only the upstreaming portion of a dust-free *coat* perpetually being renewed on the surface of the body. Let me describe the appearance and mode of seeing it by help of a diagram. [For full description see *Philosophical Magazine* for March 1884.]

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[1] For instance, the electric properties of crystals can be readily examined in illuminated dusty air; the dust grows on them in little bushes and marks out their poles and neutral regions, without any need for an electrometer. Magnesia smoke answers capitally.

Surrounding all bodies warmer than the air is a thin region free from dust which shows itself as a dark space when examined by looking along a cylinder illuminated transversely, and with a dark background. At high temperatures the coat is thick ; at very low temperatures it is absent, and dust then rapidly collects on the rod. On a warm surface only the heavy particles are able to settle—there is evidently some action tending to drive small bodies away. An excess of temperature of a degree or two is sufficient to establish this dust-free coat, and it is easy to see the dust-free plane rising from it. The appearances may also be examined by looking along a cylinder *towards* the source of light, when the dust-free spaces will appear brighter than the rest. A rod of electric-light carbon warmed and fixed horizontally across a bell-jar full of dense smoke is very suitable for this experiment, and by means of a lens the dust-free regions may be thus projected on to a screen. Diminished pressure makes the coat thicker. Increased pressure makes it thinner. In hydrogen it is thicker, and in carbonic acid thinner, than in air. We have also succeeded in observing it in liquids—for instance, in water holding fine rouge in suspension, the solid body being a metal steam tube. Quantitative determinations are now in progress.

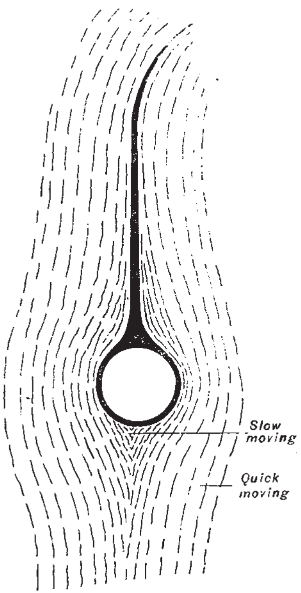

Fig. 1

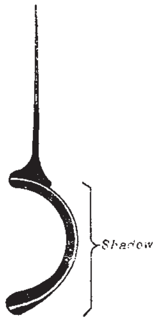

Fig. 2

Fig. 1 shows the appearance when looking along a copper or carbon rod laterally illuminated ; the paths of the dust particles are roughly indicated. Fig. 2 shows the coat on a semi-cylinder of sheet copper with the concave side turned towards the light.

It is difficult to give the full explanation of the dust-free spaces in a few words, but we may say roughly that there is a molecular bombardment from all warm surfaces by means of which small suspended bodies get driven outwards and kept away from the surface. It is a sort of differential bombardment of the gas molecules on the two faces of a dust particle somewhat analogous to the action on Mr. Crookes' radiometer vanes. Near cold surfaces the bombardment is very feeble, and if they are cold enough it appears to act towards the body, driving the dust inward—at any rate there is no outward bombardment sufficient to keep the dust away, and bodies colder than the atmosphere surrounding them soon get dusty. Thus if I hold this piece of glass in a magnesium flame, or in a turpentine or camphor flame, it quickly gets covered with smoke—white in the one case, black in the other. I take two conical flasks with their surfaces blackened with camphor black, and filling one with ice, the other with boiling water, I cork them and put a bell-jar over them, under which I burn some magnesium wire ; in a quarter of an hour or so we find that the cold one is white and hoary, the hot one has only a few larger specks of dust on it, these being of such size that the bombardment was unable to sustain their weight, and they have settled by gravitation. We thus see that when the air in a room is warmer than the solids in it—as will be the case when stoves, gas-burners, &c., are used—things will get very dusty ; whereas when walls and objects are warmer than the air —as will be the case in sunshine or when open fireplaces are used, things will tend to keep themselves more free from dust. Mr. Aitken points out that soot in a chimney is an illustration of this kind of deposition of dust ; and as another illustration it strikes me as just possible that the dirtiness of snow during a thaw may be partly due to the bombardment on to the cold surface of dust out of the warmer air above. Mr. Aitken has indeed suggested a sort of practical dust or smoke filter on this principle, passing air between two surfaces—one hot and one cold—so as to vigorously bombard the particles on to the cold surface and leave the air free.

But we have found another and apparently much more effectual mode of clearing air than this.[1] We do it by discharging electricity into it. It is easily possible to electrify air by means of a point or flame, and an electrified body has this curious property, that the dust near it at once aggregates together into larger particles. It is not difficult to understand why this happens: each of the particles becomes polarised by induction, and they then cling together end to end, just like iron filings near a magnet. A feeble charge is often sufficient to start this coagulating action. And when the particles have grown into big ones they easily and quickly fall. A stronger charge forcibly drives them on to all electrified surfaces, where they cling. A fine water-fog in a bell-jar, electrified, turns first into a coarse fog or Scotch mist, and then into rain. Smoke also has its particles coagulated, and a space can thus be cleared of it. I will illustrate this action by making some artificial fogs in a bell-jar furnished with a metal point. First burn some magnesium wire, electrify it by a few turns of this small Voss machine, and the smoke has become snow ; the particles are elongated, and by pointing to the charged rod indicate the lines of electrostatic force very beautifully : electrify further, and the air is perfectly clear. Next burn turpentine and electrify gently : the dense black smoke coagulates into black masses over an inch long ; electrify further, and the glass is covered with soot, but the air is clear. Turpentine smoke acts very well, and can be tried on a larger scale : a room filled with turpentine smoke, so dense that a gas-light is invisible inside it, begins to clear in a minute or two after the machine begins to turn, and in a quarter of an hour one can go in and find the walls thickly covered with stringy blacks, notably on the gas-pipes and everything most easily charged by induction. Next fill a bell-jar full of steam, and electrify, paying attention to insulation of the supply point in this case. In a few seconds the air looks clear, and turning on a beam of light we see the globules of water dancing about, no longer fine and impalpable, but separately visible and rapidly falling. Finally make a London fog by burning turpentine and sulphur, adding a little sulphuric acid, either directly as vapour or indirectly by a trace of nitric oxide, and then blowing in steam. Electrify and it soon becomes clear, although it takes a little longer than before ; and on removing the bell-jar we find that even the smell of SO_2 has disappeared, and only a little vapour of turpentine remains. Similarly we can make a Widnes fog by sulphuretted hydrogen, chlorine, sulphuric acid, and a little steam. Probably the steam assists the clearing when gases have to be dealt with. It may be possible to clear the air of tunnels by simply discharging electricity into the air—the electricity being supplied by Holtz machines, driven say by small turbines—a very handy form of power, difficult to get out of order. Or possibly some hydro-electric arrangement might be devised for the locomotive steam to do the work. I even hope to make some impression on a London fog, discharging from lightning-conductors or captive balloons carrying flames, but it is premature to say anything about this matter yet. I have, however, cleared a room of smoke very quickly with a small hand machine.

It will naturally strike you how closely allied these phenomena must be to the fact of popular science that "thunder clears the air." Ozone is undoubtedly generated by the flashes, and may have a beneficial effect, but the dust-coagulating and -expelling power of the electricity has a much more rapid effect, though it may not act till the cloud is discharged. Consider a cloud electrified slightly; the mists and clouds in its vicinity begin to coagulate, and go on till large drops are formed, which may be held up by electrical action, the drops dancing from one cloud to another and thus forming the very dense thunder-cloud. The coagulation of charged drops increases the potential, as Prof. Tait points out, until at length—flash—the cloud is discharged and the large drops fall in a violent shower. Moreover, the rapid excursion to and fro of the drops may easily have caused them to evaporate so fast as to freeze, and hence we may get hail.

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[1] See NATURE, July 26, 1883 (p. 297).

While the cloud was electrified, it acted inductively on the earth underneath, drawing up an opposite charge from all points, and thus electrifying the atmosphere. When the discharge occurs this atmospheric electrification engages with the earth, clearing the air between, and driving the dust and germs on to all exposed surfaces. In some such way also it may be that "thunder turns milk sour," and exerts other putrefactive influences on the bodies which receive the germs and dust from the air.

But we are now no longer on safe and thoroughly explored territory. I have allowed myself to found upon a basis of experimental fact a superstructure of practical application to the explanation of the phenomena of nature and to the uses of man. The basis seems to me strong enough to bear most of the superstructure, but before being sure it will be necessary actually to put the methods into operation and to experiment on a very large scale. I hope to do this when I can get to a suitable place of operation. Liverpool fogs are poor affairs, and not worth clearing off. Manchester fogs are much better and more frequent, but there is nothing to beat the real article as found in London, and in London if possible I intend to rig up some large machines and to see what happens. The underground railway also offers its suffocating murkiness as a most tempting field for experiment, and I wish I were able already to tell you the actual result instead of being only in a position to indicate possibilities. Whether anything comes of it practically or not, it is an instructive example of how the smallest and most unpromising beginnings may, if only followed up long enough, lead to suggestions for large practical application. When we began the investigation into the dust-free spaces found above warm bodies we were not only without expectation, but without hope or idea of any sort, that anything practical was likely to come of it: the phenomenon itself possessed its own interest and charm.

And so it must ever be. The devotee of pure science never has practical developments as his primary aim; often he not only does not know, but does not in the least care, whether his researches will ever lead to any beneficial result. In some minds this passive ignoring of the practical goes so far as to become active repulsion; so that some singularly biased minds will not engage in anything which seems likely to lead to practical use. I regard this as an error, and as the sign of a warped judgment, for after all man is to us the most important part of Nature; but the system works well nevertheless, and the division of labour accomplishes its object. One man investigates Nature impelled simply by his own genius and because he feels he cannot help it: it never occurs to him to give a reason for or to justify his pursuits. Another subsequently utilises his results, and applies them to the benefit of the race. Meanwhile, however, it may happen that the yet unapplied and unfruitful results evoke a sneer, and the question, "Cui bono?" the only answer to which question seems to be: No one is wise enough to tell beforehand what gigantic developments may not spring from the most insignificant fact.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The following are the University and College lectures in natural science for the summer term:—

In the Physical Department of the Museum Prof. Clifton lectures on the instruments and methods of measurement employed in optics; Mr. Heaton lectures on problems in elementary physics; and practical instruction is given by the Professor and Messrs. Heaton and Walker. At Christ Church Mr. Baynes lectures on conduction of heat, and gives practical instruction on the measurements of electricity and magnetism; at Balliol Mr. Dixon lectures on elementary electricity and magnetism.

In the Chemical Department of the Museum Dr. Odling will hold an informal discussion on chemical constitution, Mr. Fisher lectures on inorganic and Dr. Watts on organic chemistry. At Christ Church Mr. Harcourt lectures on quantitative analysis and Mr. Veley on the relation between the physical properties and the constitution of organic compounds.

In the Morphological Department of the Museum Prof. Moseley lectures on the relations of the anthropoid apes and man, Mr. S. Hickson on the embryology of the chick, Mr. Jackson on Osteological Types, Mr. Poulton on Descriptive Histology, Mr. Morgan on Odontography, and Mr. Barclay-Thompson on the Anatomy of the Sauropsida.

In the Physiological Department Prof. Burdon-Sanderson lectures on the Chemical Processes of the Animal Body; at Magdalen Mr. Yule lectures on Practical Physiology.

Prof. Prestwich lectures on the Strata in the Neighbourhood of Oxford, and gives practical instruction in the field on the days following his lectures.

Prof. Gilbert will give an introductory lecture on May 6, on the Sources of the Constituents of Plants—the Soil, the Atmosphere. Dr. Tylor lectures on the Development of Arts and Sciences.

Prof. Pritchard concludes his course on the Planetary Theory, and will give a public lecture on his recent journey to Egypt in order to measure the absorptive power of the atmosphere on the light of the stars.

SCIENTIFIC SERIALS

American Journal of Science, April.—Recent explorations in the Wappinger Valley limestone of Duchess County, New York, by Prof. William B. Dwight. To the paper is appended a plate of the Wappinger Valley fossils.—Description of the Kettle-Holes near Wood's Hall, Massachusetts, with map of the district showing the positions and direction of the larger diameter of the Holes, by Prof. B. F. Koons.—Examination of Mr. Alfred R. Wallace's modification of the physical theory of secular changes of climate (second paper), by Dr. James Croll. Here the question is studied from the physical standpoint, and it is argued that a geographical change in the crust of the earth is not necessary to remove the Antarctic ice.—A contribution to the geology of Rhode Island (continued), by T. Nelson Dale.—On Mesozoic Dicotyledons (Angiosperms), by Lester F. Ward.—On the tourmaline and associated minerals of Auburn, Maine, by George F. Kunz.—On andalusite from Gorham, Maine, by the same author.—On the white garnet from Wakefield, Canada, by the same author.—Horizontal motions of small floating bodies in relation to the validity of the postulates of the theory of capillarity, by John Le Conte.—The principal characters of American Jurassic Dinosaurs; Part vii., the order Theropod (with plates 8 to 14), by Prof. O. C. Marsh.—A new order of extinct Jurassic reptiles (*Macelognatha*), (one illustration, *M. vagans*), by the same author.

THE first article in the *Journal of Botany* for April is a monograph, by Dr. Masters, on the singular "umbrella pine" of Japan, *Sciadopitys verticillata*. The most important points which he brings out are that the true leaves of *Sciadopitys* are the homologues of the true or primordial leaves of *Pinus;* that the so-called "needles" of *Sciadopitys*, although occupying the same relative position as the leaves of *Pinus*, are not necessarily morphologically homologous with them; and that the bracts of the cone of *Sciadopitys* are homologous with the true leaves of that plant, and also with the bracts of Abietineæ generally.

THE most important article in the *Nuovo Giornale Botanico Italiano* for January 1884 is one by Sig. A. Borzi, on a parasitic organism of a very low type which he finds in the ordinary cells of *Spirogyra crassa*, and to which he gives the name *Protochytrium Spirogyræ*. In its systematic position it displays, on the one hand, affinities with the Myxomycetes, on the other hand, with such genera of Chytridiaceæ as *Woronina*, *Rozella*, and *Olpidiopsis*. The entire absence of a cell-nucleus identifies it, according to the author, with Klein's family of Hydromyxaceæ, along with *Monas*, *Vampyrella*, *Monadopsis*, and *Protomyxa*. Its ordinary condition is that of a naked mass of protoplasm, endowed with amœboid movements, and living on the chlorophyllaceous contents of the cells of the host, these plasmodia having the power of coalescing like myxamœbæ; but it also has an encysted state, and in certain conditions propagates itself by the production of uniflagellate zoospores.

Rendiconti del Reale Istituto Lombardo, March 6.—Observations made at Milan on the passage of the atmospheric waves produced by the Krakatoa eruption, by E. G. Schiaparelli.—On